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Abstract

DEVELOPMENT AND BASIC CHEMISTRY OF A LARGE SCALE MANUFACTURING PROCESS AND PLANT FOR PLUTONIUM FAST REACTOR FUEL

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This paper describes the development work now in progress from which future large scale plants for the production of plutonium fast reactor fuel elements in the U.K. will be designed.

The work of selecting the fuel, and of specifying the fuel element design is now proceeding and although at this stage these cannot be finalised, the work will form the starting point for the fuel element process and plant development.

The purpose of the plant required may be divided into three categories:- (a) raw fuel material production, (b) manufacture of fuel into a compacted form, and (c) fabrication of fuel elements. Consideration of the special requirements of criticality, shielding, containment and active maintenance, as applied to a large scale production facility, leads to the conception of continuous operation using safe by shape linked equipment for the bulk fuel,

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sections (a) and (b), and of a production line largely influenced by pin movement considerations, for section (c).

The development for each of these sections is proceeding by way of inactive and uranium based equipment studies in the first instance, leading to initial versions of plant suitable for use with plutonium, and finally to a full demonstration of the plant and containment on a scale giving approximately the output required to support the prototype fast reactor.

The first section of the plant is based on the preparation of mixed Pu/U oxides by continuous coprecipitation from solution with ammonia, using a novel multistage precipitation technique, the chemistry and theory of which are described. The product is continuously filtered, washed and dried and then subjected to calcination, reduction and surface area adjustment in a single stage. The resulting oxide powder possessing the requisite homogeneity, is then converted into a compacted form in a continuous granulation plant, which includes a novel spheroidisation process. This forms the feed for either a pelleted or a vibro-compacted fuel product. Should carbide be required, it is possible to add to this system, equipment for the oxide/carbon reduction process, and thus the fuel production plant is being developed on very flexible lines.

After sintering to high density the fuel is loaded into cans and plant development is concerned largely with the layout of a system for transferring fuel pins of awkward shape along a series of consecutive loading, sealing, welding, etc. operations at a reasonable production rate.

A demonstration plant embodying all these sections is now in the course of erection at Aldermaston.